Improving and Expanding Solid Waste Collection in Manado, North Sulawesi, Indonesia




Summary of Pilot Projects

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Summary of Pilot Projects

An important part of this project centered around five pilot projects that took place in February and March 2004. These pilot projects aimed to address key opportunities for technical improvements and behavior modification that impact Manado's overall solid waste management. The pilot projects offer practical, realistic and affordable solutions to select solid waste management issues in Manado. Their easy replicability means their impact can be felt in a larger context if taken further by the citizens and officials in Manado.

The pilot projects address several technical issues, all which focus on reducing solid waste volume by waste generators ***before*** the waste reaches communal waste storage locations (TPS, or containers). With a lower waste volume, the burden of transferring waste to TPA (the final disposal sight, or landfill) is relatively lighter. This allows for more efficient use of city resources for waste management and maximizing the lifetime of investments. Reducing waste volume focused on:

- Composting organic waste particularly at the household level, as household waste in Manado is the largest part of municipal solid waste and a large percentage of it is organic.
- Sorting inorganic material at the household level so it can be recycled. Manado has an established informal market for such materials although awareness of it is relatively low.
- Working with the lowest levels of government to improve select technologies in solid waste management. This involved improving a collection system using carts that were whose needs and costs were planned for, and examining why frequent drain clogs in one sub-district are a recurring problem.

A critical component of all the pilot projects included technical familiarization and monitoring that was conducted with as many stakeholders as possible. Such on-going stakeholder involvement is essential for future success.

Socialization efforts were made jointly with various parties who feel responsible for improving solid waste management. Such stakeholders include city officials, particularly through BPK and BPLH, districts, sub-districts, neighborhoods, PKK (family welfare movements) (from city level down to neighborhood level), NGOs, community empowerment bodies, legislators, students doing social action internships, citizens and the mass media. "Lestari" has brought significant attention to waste issues to the public at large.

During pilot project implementation, reports on all activities were routinely given to the City's sanitation agency (BPK) to the Head of Planning, Research and Development/Extension Division. In the future other districts/sub-districts/markets can use these pilot projects as a model to be applied in their areas.

Lessons learned from the pilot projects include:

- Waste management should be conducted locally to the best possible extent, as the pilot project on Siladen Island demonstrates.
- Where possible, waste management improvement should be linked to economic benefits. As the sorting/recycling activity indicates, there are financial rewards for waste separation.
- A well informed public is critical for behavior change, and solid waste management improvements are constrained without greater public awareness that everyone is responsible for waste management (not just the government).

Siladen Island

Siladen Island is part of Manado City located in Bunaken Sub-district, Bunaken District. Although Bunaken is the landmark of Manado City, the region includes other small islands located in Manado Bay of which Siladen is one. The pilot project was carried out on Siladen Island with the hope that the success made in improving solid waste management locally and independently can serve as a model for other islands

Considerations for choosing Siladen as a pilot project included:

- There are several parties, in particular the management of Siladen Resort & Spa, who are concerned about the cleanliness of the island.
- Thus far, assistance activities often do not reach Siladen Island.
- The resort often has to "re-send" some of its waste to Manado, because they do not want to burn or bury the waste in the island. In addition to the expense, this is often disrupted when there are storms as boats transporting waste cannot easily reach Manado.
- In general the community does not realize that organic waste can be composted to be used as fertilizers for plants.
- After storms, it is evident other islands' waste arrives on Siladen Island's shores. Although some of this waste is from Siladen, some of it is from other islands and Manado.

The general profile of Siladen Island is as follows:

- It is within the area of Neighborhood VI, Bunaken Sub-district, Bunaken District
- Population: 280 people
- Number of households: 82 families
- Management of the resort's waste:
  - Organic waste from kitchens is used for animal feed
  - Organic waste from leaves is buried and/or transported to Manado periodically
  - Inorganic waste is transported periodically to Manado
- Management of community's waste:
  - Organic waste from kitchens is used for animal feed
  - Organic waste from leaves is combusted and/or buried
  - Inorganic garbage is disposed and/or buried

Together with the resort management and the community, the SWM team conducted several activities, namely:

<u>Simple composting with the help of EM4 microorganisms (effective microorganism):</u>

This activity was conducted in two places, on the front yard of a local resident and in the resort area. Most materials composted were organic waste from fallen leaves, mixed with wood shavings existing on the island. Maturation process using EM4 shortens the time

for composting by seven days. Then the waste that had become bokashi compost (organic fertilizer) can be used for decorative or productive plants.

Composting using composters:

This activity was conducted in the front yard of a local resident. One composter was installed to provide an alternative in the handling of organic waste, particularly small scale waste, from households. Although some organic waste originating from food or kitchen remains is used for animal feed (particularly pigs), the remainder can be disposed into the composter.

Sorting and reuse of inorganic waste:

This activity was conducted at the resort as proper disposal of drinking water bottles is a particular problem. Since many homes have refrigerators, most of the bottles can be reused for cold water/ice. Meanwhile, glass bottles, used beer bottles, etc, can be reshipped to Manado City to be sold, either to used beverage bottle collection units or to other parties.

Addressing these two matters reduces the burden imposed on inorganic waste storage locations existing in the resort. Furthermore, such activities make solid waste management more "localized," and as much organic waste as possible can be transformed into a beneficial form like compost.

Actions to be taken in the future:

- With a relatively large amount of organic waste in the form of fallen leaves (there were approximately 2.5 tons of fallen leaves piled in February 2004), composting can produce a large amount of organic fertilizer. The compost has been used for productive plants that are suitable locally. This can be further developed for plants usually bought in Manado. If this can be implemented, the need of the islanders /the resort to shop for fertilizer in Manado can be substituted for local products.
- The sweep-the-beach program should be continued. Information about the poor condition of the beach due to non-Siladen Island waste needs to be distributed widely, so that it may motivate other waste generators, particularly those disposing waste along rivers passing through Manado.

PK (Needs Assessment), ABP (Full Cost Accounting), Cart System

PK and ABP activities were conducted together with applying a solid waste collection system using carts. One of the considerations for selecting this pilot project is that there are still many sub-districts and markets requiring additional carts. Therefore, by linking the procurement of carts with PK and ABP, the implementation will be more integrated. PK and ABP activities, as well as cart procurement, were conducted in two locations, namely Lawangirung Sub-district, Wenang District and Bersehati Market.

Lawangirung Sub-district

The pilot project was conducted cooperatively with the RTI SWM Team and the Head of the Public Service & Taxation Section who concurrently serves as the Head of the Waste Management Decentralization Project for the areas of Wenang District and Lawangirung Sub-district.

Considerations for selecting Wenang District, Lawangirung Sub-district as a pilot project included:

- The sub-district does not have a primary collection system. People prefer taking their waste to their front yard as opposed to taking it to TPS/containers.
- It has already had a communal disposal location in the form of TPS.
- The area is relatively flat so it is suitable for a collection system using carts pulled by men.
- At present, in this sub-district residents either dispose their waste directly to TPS or store it in front of their houses in plastic bags. Waste stored in front of houses is taken by sub-district personnel to TPS although no fee is charged for this service. Alternatively, children will collect the waste for Rp.1,000 per disposal. This shows a willingness to pay on the part of the community.
- There are still many Manado residents willing to collect waste door to door. They are spread across six neighborhoods existing in the sub-district. They are mostly migrants, not natives of Manado, and are willing to transport waste provided they are given appropriate compensation.
- There is a strong desire among community members to have a better waste management system. This is reflected by the aspirations conveyed by the sub-district office, indicating that waste management program improvement is the sub-district's top priority for the year 2004.

The profile of Lawangirung Sub-district is as follows:

- Population : 4,496 persons
  - Neighborhood I: 624 persons
  - Neighborhood II: 719 persons
  - Neighborhood III: 1,129 persons
  - Neighborhood IV: 347 persons
  - Neighborhood V: 948 persons
  - Neighborhood VI: 729 persons
- Number of households: 1,050

- Population/household: 4,496/1,050= 4 persons/household
- Number of houses & office buildings: 679
  - Number of households/house: 1,050/679=1.5 households/house
- Number of neighborhoods: 6
- Area : 25,6 ha

As a part of the pilot project, an integrated waste management system was established to include community members, which was facilitated by the sub-district office (the smallest government administrative institution). Community participants included: community empowerment bodies, religious figures, youth organizations, mosque and church youth members and concerned citizens.

This pilot project process included:

1. Establishment of institutions for improving solid waste management so the community is involved in determining, and understands, what organization/institution will be responsible for fee collection and for management of supporting SWM facilities.
2. Identification of SWM priorities, needs for supporting facilities, collection personnel requirements, operational and maintenance costs for the services provided and calculation of an acceptable community fee for such services.

Assuming one person generates 2.5 liters of waste per day, the potential production of waste in Lawangirung Sub-district is 11.27 m3/day. As carts have the capacity of 0.8 m3 and 2 trips/day are used, 7 carts are needed. However, considering that there are 6 neighborhoods in the sub-district, it was agreed to procure 6 carts.

Service needs:

a.	Cart:	6 units
b.	Manpower:	6 persons
c.	Rake:	6 units

Cost for services:

a. Manpower:	Rp.250,000/person/month:		1,500,000/month
b. Rake:	Rp. 35,000/unit:		210,000/month
c. Maintenance:	Rp. 25,000/unit/month:		150,000/month
	total cost:	Rp.	1,860,000/month

Calculation of community fee:

Number of households:1,050

Fee: 1,860,000/1,050: around Rp. 2,000/household/month

3. Familiarization and Implementation of new fees: the process began at the outset of PK and ABP development. Active inputs and participation from community empowerment bodies, PKK, and Youth Organizations were fundamental in development of the system. Their commitment to participating in the process is evidence of strong community determination to have a better system.

With project support, six carts have been used to collect waste door to door. The fee collection system was trial tested to check its suitability. Fees charged will not be uniform, but it will take into account the capability and willingness of each waste generator to pay. When the intent to charge a monthly fee of Rp. 2,000-Rp. 2,500 per household was communicated, there was very little objection from residents. In essence, they are willing to pay in proportion to the service they obtain.

Actions to be taken in the future:

Suggested technical improvements:

- Use of a trumpet to indicate waste disposal hours have started and and to announce carts have arrived in particular locations.
- Creation of smaller carts to reach steep areas, particularly Neighborhoods V and VI.
- Rehabilitation of Waste Storage Locations (TPSs), as the large quantity of waste scattered around them may be caused by improper design.

Suggested non-physical improvements:

- Application of cross subsidies in the determination of waste disposal fee .
- Use of collection vehicles (pick up kijang)
  - Funding could be sought from business owners in the sub-district

Bersehati Market

The pilot project in Bersehati Market was conducted jointly with the Head of the Hygiene Section of the Market Management Agency and the Head of the Bersehati Market Unit. Problems facing Bersehati Market include informally disposed garbage around the market and a lack of capacity to effectively collect waste on a daily basis. In addition, this market was selected as a pilot for the following reasons:

- The relative separate location of the market's facilities from the "micro" terminal (city transportation)
- This market does not presently have a revitalization plan, unlike the Pinasungkulan Market that will be jointly managed with a private party
- The market's close proximity to the sea means ineffective SWM further complicates SWM in other parts of Manado and its islands.

Bersehati Market is located in Wenang District. As an independent part of the Market Management Agency, hygiene management is under the authority and the responsibility of the Head of the Bersehati Market Unit. However, the Market Management Agency also has a role to play in hygiene management, particularly in the provision of facilities.

Garbage collection in Manado's markets is generally done with carts that are rented for Rp.10,000 per cart per day. Collection occurs once or twice per day. Collectors are non-permanent workers from the Market Management Agency. The collectors are paid Rp.14,600 per person per day or about Rp.552,000 per month (maximum 31 days per month), including a meal allowance of Rp.100,000 per month.

Bersehati Market produces 49 m3 of waste per day, while the quantity of waste that can be collected is only 37 m3/day, or 76% of waste generated. Collection vehicles make five trips to the TPA every day.

Bersehati Market's hygiene management resources include::

- 1 dump truck
- 1 arm roll
- 2 containers
- 2 drivers
- 6 crews
- 17 street sweepers

Bersehati Market's waste is transported by a dump truck and an arm roll truck to Sumompo TPA located about 5 km from the Market.

There are two waste disposal tariffs:

- Permanent Kiosks: between Rp. 2,500 ~ Rp. 7.500 per month
- PKLs (street vendors): Rp. 300 per day (collected daily)

Bersehati Market collects the following income for waste disposal services provided:

- Kiosks: 170 kiosks x Rp. 5,000 (on average) = 850, 000 per month
- PKLs: 1,160 sites x Rp. 300 = Rp. 348,000 per day
- Hence approximately Rp.10.4 million is earned every month.

With the existing number of street sweepers collecting waste with carts, Rp.9.35 million per month is required for labor costs and Rp.1.5 million per month is required for renting carts. It is evident that at present the market can barely cover the waste collection costs, let alone pay for transportating waste to TPA. In addition, maintenance costs for primary and secondary collection are not included.

In the pilot project the market was divided into three management areas. As a preliminary measure, three carts with a 0.35 m3 capacity were provided. These carts were used primarily to transport waste from the interior part of the market. The market's exterior, for the time being, will continue to be directly handled by street sweepers who remove waste to containers and/or collection vehicles.

The Market Management Agency will continue to utilize rented carts while it gradually prepares additional carts, for Bersehati Market and other markets in its jurisdiction. For the new carts provided in the pilot project, and for new carts that will added in the future, a new contractual arrangement will be in place with the collectors, including:

- A contract in place between the Management Agency of Bersehati Market and each cart pusher
- Definition of operational area for each cart pusher
- Operational hours (transportation trip)
- Performance Review (quantitative and qualitative evaluation)

Actions to be taken in the future:

With regard to cart collection the Market Management Agency, particularly Bersehati Market, could to centralize waste collection in the form of providing additional TPSs or containers. At present the lack of adequate disposal sites leads to informal waste disposal which is not only unhygienic, visually unappealing, but also impairs the actually collection and transfer that does place.

The Market Management Agency can also prevent organic waste from entering into the city's waste stream by observing the following:

- Most market waste is organic, from the leftovers of vegetables/fruits
- The percentage of market waste that is not transported to TPA is high
- A large amount of waste is dumped to rivers and the sea, often after being left in an informal collection pile at the market for several days
- The transportation of vegetables and fruits primarily uses one lane, namely the south one

Proposed future activities include:

- Preparation of one entry point for the Manado Region.
- Direct vehicles with vegetables and fruits to the aforementioned area, where separation can take place. As only the clean vegetables and fruits go on to be transported to Manado, the rest is usually thrown away.
- Using separation, this organic waste can be composted and the composted material can be sold to farmers in the nearby areas.

If the above can be performed, the following benefits can be achieved:

- The volume of waste will significantly decrease, which will allow limited resources to be spent on collecting non-organic waste, lead to a cleaner and more hygienic market.
- The load of vehicles transporting vegetables and fruits will be reduced, although extra time to remove non-retail produce will be required.
- Significant organic waste can be processed to be organic fertilizer.

Composting

To date there is no waste sorting process in Manado. Garbage containers contain both inorganic and organic waste, starting from the producer level, the TPS/Container Level to the TPA level. With aggregate household waste producing 1,150 m3 of waste per day, and markets producing 205 m3 of waste, total waste production is 1,355 m3/day.

If 50% of this waste is organic, there is enormous potential for waste separation and productive use of organic material. Aside from the negative impact of system overloading that such waste levels produce, a high percentage of organic material is in fact an opportunity. If waste is separated the organic material can be composted and then be reused and/or resold.

With Manado's continued urbanization, the city will face increasing pressure on its SWM system. In acknowledging urban constraints, this pilot project demonstrated how a low cost backyard composting system can be utilized in Manado. The composter is a plastic drum which is 80 cm tall with a diameter of 50 cm. The composting process is simple, whereby the household places food leftovers inside the composter. After two months the household will have composts. In this process, there is no assistance from microbes, worms, etc. Composting is a natural process and even maggots are not found during the composting process.

Composter capacity is:

- Diameter: 50 cm (effective)
- Height: 80 cm (effective)
- Volume: 0,16 m3 (160 liter)

Small family: 4 persons (parents & children)

- Production: 2,5 lt./person/day, or 10 lt./house/day
- Assuming 50% of waste is organic, this is 5lt/house/day
- Production: 1 lt. organic wastes/house/day (assumption: 80% undergoes decrease of volume mainly caused by decomposition)

→ thus the capacity of the composter is: 157 days or about 6 months

The composter's lifetime will be lengthened if only food leftovers are put inside. This particular composter is designed for only food items. Equipped with a cover, bad smell and bug disturbances (flies for example) can be minimized.

To maximize exposure to composting, composters were widely installed in several locations in Manado, including:

- Siladen (as described above)
- Ranotana Sub-district
- Tanjung Batu Sub-district
- Paal IV Sub-district
- Sario District

- Tingkulu Sub-district
- Pakowa Sub-district
- Wanea District
- Sario Kota Baru Sub-district
- Mapanget Barat Sub-district
- Malalayang I Sub-district
- Ranomuut Sub-district

In addition, two composters were installed with a local public service organization, the PKK or Family Welfare Organization. Members are largely spouses of sub-district personnel and the Mayor's wife is very active in the organization. PKK took a strong interest in composting after learning more about the process through the pilot project.

Installation challenges included:

- Due to varying physical characteristics, some locations require two hours to dig 90 cm with the diameter of about 70~80 cm.
- Manado's surface ground water is rather shallow. Sometimes identifying where to place the composter can be complicated, or the barrel is only half buried. In the latter situation the part above ground still needs to be buried for optimal composting.

Actions to be taken in the future:
Although there was widespread interest in composting through the pilot projects, continued socialization and public awareness building is required for on-going success. Widespread public information campaigns and demonstrations should continue to take place at the municipal, district, sub-district and neighborhood levels. As this composter is quite simple, easy to use and low cost, replication can happen quickly.

If the cost of purchasing composters is too expensive for an average household, the *arisan* system (or small savings scheme where participants make monthly contributions over time to reach a goal) could be employed. For example, 20 participants pay for fee in the amount of about Rp.15,000 per month, then within 20 months, there will be 20 households having composters installed in their houses.

On-going public education is also a critical element for successful implementation of backyard composting. The widespread interest in composting that was generated by this pilot project, as evidenced by much further demand for composters than the team had anticipated, shows that 'word of mouth advertising' is welcomed and popular.

Drainage Cleaning

Water channels in many areas of Manado are frequently clogged with domestic waste, garbage, wood and tree cuttings, particularly during the rainy season. Although this is not a highly visible problem to the public as many clogged ditches/rivers are located behind houses, the flooding caused by these clogged drains affects many households.

The district already had an established 'Clean Friday' program. However, the SWM team encouraged the district to expand these activities to drainage cleaning which had previously not been a part of Clean Friday. The SWM Team jointly with Sario District attempted to clean ditches located between Sario Sub-district and Sario Utara Sub-district areas that frequently become the cause of clogging and inundation especially during the rainy season.

Working jointly with the Sario District staff, the team discovered the following observations about these frequent clogs:

- The source of clogging originates from a "PDAM 4" pipe crossing several centimeters above water surface. If water currents carry floating materials (for example, plastic bottles), they will be blocked by the pipe. Gradually, more debris gathers to the point where water cannot flow through the ditch.
- The effective depth of the ditch is significantly reduced by sedimentation from wood objects.
- Problems in this district are exacerbated by improper garbage disposal in other parts of Manado—like Ranotana Sub-district area, Kleak Sub-district (Malalayang District), and areas surrounding Klabat Stadium. Garbage from these areas, especially used drinking water bottles, eventually ends up in the ditches.
- Consequently, even though the ditch in Sario is frequently cleaned, it is continually clogging. It is blocked within two weeks of cleaning. Each cleaning costs Rp.150,000 and most garbage is not coming from the Sario District residents. There is a reluctance in Sario to continue paying for cleaning when the garbage and debris is from somewhere else.

Activities in this pilot project included:

- Assisting the district with ditch cleaning, to understand what types of materials are most frequently clogging it. Hoes, harrows and shovels were used. Materials clogging the surface were primarily plastic drinking water bottles. Materials clogging the bottom part of the ditch were used wood, including banana tree trunks. It is believed the banana tree trunks are from residents living within these two pilot project sub-districts
- Assisting with transporting the removed garbage/materials to the nearest TPS/containers. Materials were transported using a car owned by one of neighborhood heads, which required four trips to the TPS. One cart from Sario Utara sub-district was also used.

- Several trees had fallen across the ditch which was also contributing the the blocked ditch. The team assisted in cutting of and removing these trees.
- Informing PDAM that their pipe should be moved from this ditch, which was cut one week later and redirected.
- Posting of warning boards to the public prohibiting garbage disposal in the ditech, which was done in five places most prone to informal disposal.
- Placement of additional garbage containers in places prone to informal dumping, to encourage proper disposal.

Actions to be taken in the future:

Clean Friday activities can be expanded to the "back yard" of an area, not just to the "front yard." Doing this would solve more problems coming from upstream, due to physical conditions and behavior patterns. Many houses in Manado still dispose of garbage in their back yards, i.e. throwing waste directly into ditches/rivers. If ditch cleaning is conducted in back yards and actively involves home owners, this should lead to discouragement of this negative behavior.

Ditch cleaning activity should be integrated with other existing programs such as sea sweeping and beach sweeping, to further raise public awareness of proper waste disposal and the implications of not doing this.

Garbage Sorting

Although not widespread in Manado, recycling some inorganic waste can reduce overall pressure on the City's overall system. The team realized there are early signs that recycling is an option in Manado because:

- There are a number of scavengers at producer (house) level, TPS/container level, and TPA level.
- There are several buyers for materials collected by scavengers, especially for plastic bottles, cartons, irons and metals, glass bottles, cans and newspapers. The system is highly informal, but can be generalized into two types of interactions: One, passive buying of recycled materials where scavengers deliver items to the buyer. The second is more active where buyers go directly to scavengers, or even have their own 'regular' scavengers.

More formalized recycling efforts, mainly waste separation at the home or TPS/container levels, would help some of the inefficiencies of the system as it is now. For example, presently scavengers will spread garbage outside the TPS/container to find recyclable materials, i.e. scattering garbage.

Neighborhood IV of Ranotana Sub-district, Sario District was selected a pilot project for waste sorting in light of these observations:

- Primary waste collection system in the sub-district is relatively more well-established, indicated by:
  - Waste collection already happens with a kijang, with a door to door pick up system in stipulated hours
  - Residents are permanent, with high education and employment levels.
  - Waste management is conducted in an accountable and transparent manner.
  - Multiple stakeholders are involved in waste management, and conduted jointly by LPM and the neighborhoods.
- Theere is a growing number of scavengers in the sub-district area.

Neighborhood IV consists of about 110 families in a relatively flat area. The profile of garbage service as it is presently provided is:

- Door to door garbage transportation starts at 16:00 each day
- Garbage is organic and inorganic waste
- Garbage disposal fee is Rp.5,000 per household per month and Rp.2,000 per room per month (for boarding rooms)
- The fee is paid to appointed collectors

Pilot project activities included:

- Frequent socialization of the pilot sorting program, conducted by neighborhood heads, especially at religious events. Sub-district Heads also conduc took upon a concerted socialization campaign to education residents.

- 110 plastic bags were distributed in the neighborhood and residents were asked to place plastic and glass bottles in them for later sorting. The plastic bags do not have to be collected on a daily basis, since they will not cause odors. However, field observation indicated that most houses hand over the plastic bags every day.
- Garbage sorting happens at the same time as collection. Organic waste is disposed of in the TPS across from Klabat Stadium. Plastic bottles are collected to be sold after reaching certain volume.
- Residents' awareness of scavenging was increased.
- The sub-district garbage manager's awareness was also raised that many materials collected actually have economic value. After he visited a reused plastic buyer in Manado, he better understood what types of materials were in demand so these materials could be collected directly by the sub-district to the buyer.

Actions to be taken in the future:
On-going socialization of garbage sorting should continue at the household level. If sorting succeeds in Neighborhood IV, it can be extended to other neighborhoods in Ranotana Sub-district. On-going commitment from the garbage disposal administrator should also continue as his support was critical to the success of this initiative (a continued commitment that can be expected, considering Ranotan Sub-district was ranked the cleanest sub-district in 2003). The next challenge is in improving the service system, either in technical-operational aspects, financial sustainability, and in citizen participation.

This new sorting during the garbage collection should not disrupt the collectors'work productivity. As collection should be as efficient as possible, performance monitoring should be conducted consistently.